2 Ware River Watershed Background

2.1 Physical Characteristics

2.1.1 Location and Topography

The Ware River Watershed lies in the Central Uplands in North Central Massachusetts (see Figure 2). It is characterized by rolling hills separated by broad river valleys, and is contained within the Worcester Plateau and the Lower Worcester Plateau EPA ecoregions. For the purposes of this land management plan, the watershed of interest is above the Intake Works at Shaft #8**.** The watershed above this intake covers 96.8 square miles, or 61,952 acres. It encompasses parts of eight towns: Barre, Hubbardston, Oakham, Phillipston, Princeton, Rutland, Templeton and Westminster. The highest elevation, at 1,720 feet above sea level, is near the summit of Mount Wachusett on the northeast edge of the watershed. The lowest elevation, at 650 feet above sea level, is at Shaft #8, located on the extreme southwestern edge, for a difference in elevation of 1,070 feet.

The Division of Water Supply Protection currently controls 23,694 acres in the Ware River watershed and holds 11 Conservation Restrictions (CRs) on an additional 787 acres. There are few areas of steep (>35%) slopes on Division lands. Harding Hill and Oak Hill are the most prominent points of relief. Two prominent ridges extend through the property. The Oakham Ridge runs east-west and defines the southern edge of the watershed, and the Burnshirt Ridge runs north-south between the Burnshirt River and Canesto Brook valleys.

2.1.2 Geology

The following information is adapted from a report by David Ashenden, former MDC Geologist.

2.1.2.1 Bedrock Geology

Bedrock of the Ware River watershed consists of high-grade complexly folded metamorphic rock heavily intruded by pegmatite. The bedrock is separated into three formations:

1. The Partridge Formation is the oldest, consisting mostly of rusty weathering schist. It is of Middle Orodovician age (450-470 million years ago).

2. The Paxton Formation is younger then the Partridge, being of presumed Silurian age (400-440 million years). The Paxton consists largely of gray granulite splitting into thin layers. It also contains a separately mapped white sulfidic schist member which contains basal quartzites.

3. The Littleton Formation is composed mostly of gray graphitic schist and is the youngest formation of the area, being lower Devonian (upper 300s to 400 million years in age).

The pegmatite is like very coarse-grained granite and has largely replaced the original rock of the three formations listed above, leaving only small amounts of the original rock but in sufficient quantity to show its former distribution. Very minor basalt was intruded during the Late Triassic to Early Jurassic, a time on the order of 180 million years ago.

The Acadian orogeny that immediately followed the deposition of the Littleton Formation left the rocks of the area with a very complexly folded structure. In the Ware River Watershed the structure appears deceptively simple as the Oakham anticline; a broad arching of the rocks on the east side of the area dip to the east and those on the west side of the area dip to the west. The Oakham anticline is, however, but one element superimposed on a more complex regional structure.

2.1.2.2 Glacial Geology

Exposure of the bedrock is limited because it is veneered by glacial drift consisting of till and outwash. In the past million years or so the area has been subjected to multiple continental ice sheets. The most recent of these melted back only about 10,000 years ago leaving most of the area covered by glacial till. There are numerous drumlins, which are mounds of glacial till ranging from a few tens of feet to more than one hundred feet in height, forming ellipsoidal hills elongated in the direction of ice flow.

Glacial meltwater left a series of extensive sand and gravel outwash deposits in most of the valleys. As the ice melted back, the meltwater followed a variety of routes, exposing newer and lower avenues of escape and leaving a series of independent but related outwash deposits. Meltwater first escaped southward through Dean Pond and the Fivemile River valley and also through Long Pond and the Sevenmile River valley. In addition, another early escape route passed southward toward Dean Pond, passing west of the present Muddy Pond and west of the drumlin at the southern limit of the Division's holdings.

As the ice retreated further northward, meltwater drainage entered a second stage. The early route to the west of Muddy Pond and the drumlin was replaced by the central route directly to Dean Pond. The southern end of Long Pond was blocked by glacial debris, and meltwater found a lower route of escape from the north end of Long Pond by a channel to Dean Pond. This channel, now dry, is still a conspicuous feature on the landscape. As the ice retreated northward during this stage, a large outwash plain, the Pine Plains outwash plain, was deposited. The bedrock surface slopes to the north but drainage down the Ware River valley was still blocked by ice. Outwash of sand and some gravel graded from the north to the south filled the depression. Deposits to the north are in excess of one hundred feet thick. Muddy Pond and the Parkers Brook valley were occupied by masses of residual ice which may have been totally buried. Subsequent melting of the ice after meltwater ceased to pass this way left the depression which is now Muddy Pond and the valley occupied by Parkers Brook, in the outwash.

A third stage of meltwater routing and outwash deposition was initiated when the ice melted back sufficiently to expose the present Ware River valley at Shaft 8. Meltwater then followed the lower route of the Ware River and ceased to escape via Dean Pond and the Fivemile River. Deposition of the Pine Plains outwash plain ceased abruptly so that today the sand terminates northward near Shaft 7 and the southern limit of Blood Swamp. Drainage from the Longmeadow Brook area was still blocked to the north by ice. Drainage therefore continued to flow south to the Long Pond area and through the channel to the west but now used a route through the Muddy Pond area and down the Parkers Brook valley. This water passed through the residual ice masses of the Parkers Brook valley, creating the esker deposits there. With continued ice front retreat during this stage, the outwash deposits of the Ware River valley north of Coldbrook formed. These deposits consist of a series of kames and eskers deposited respectively around and within the residual ice masses. The Blood Swamp and Stevens Branch Swamp areas have only minor outwash deposits. This may be due to a combination of residual ice, which left no room for outwash deposits and the apparent absence of major meltwater streams directed this way.

The fourth stage of meltwater routing occurred with the opening of the Ware River gorge below the Barre Falls Flood Control Dam. The present drainage of the area was now more or less established.

The exact details of the shift of the East Branch and the Longmeadow Brook drainage to its present course remain uncertain. There appear to have been several possible routings westward toward Blood Swamp and the more northern swamp east of Harding Hill while the East Branch narrows north of Prison Camp location remained plugged with ice. Gradually, with the melting of that ice plug, the East Branch opened and the drainage was able to follow its present route. Outwash in this section is minimal, and portions of the East Branch flow on till.

With further retreat of the ice front northward, the development of the drainage and outwash deposits was essentially a matter of outwash deposition around stagnant residual ice masses in the Burnshirt River, Canesto Brook and West Branch valleys, forming kame terraces, knob and kettle terrain, and eskers. There are minor and local complications but these will not be detailed in this summary. Gradually the ice melted out of the Ware River watershed, and with the opening of the Millers River valley to the north, meltwater ceased to flow this way and outwash deposition was complete.

2.1.3 Soils

Soils for other DCR/DWSP watersheds have been mapped by federal agencies, but the Ware River watershed area is still without a complete survey. A draft survey is under review and the final form will be incorporated into management planning for the Ware River watershed as soon as it becomes available. For the purpose of watershed management, the Ware River soils will be grouped and mapped into five classes, based upon the soil depth and drainage characteristics.

1. Excessively drained soils are usually very coarse textured, stony, and deep. Water is removed from these soils very rapidly. These soils are thick loamy sands occurring primarily on glacial outwash. These are relatively deep soils (>65") and occupy the dry portions of the river valleys.

2. Well drained thin soils are commonly of medium texture. Water is removed from the soil fairly rapidly, but is available to plants during most of the growing season. The principle soils occurring in this class are shallow soils (1-24") formed in glacial till located on the sides of hills and valleys.

3. Well drained thick soils (24-65") are formed in loamy and sandy glacial till on uplands.

4. Moderately well drained soils are wet for only a short period during the growing season but the removal of water is somewhat slow during these times. These soils consist of very deep (to 65" and greater) fine sandy loams.

5. Poorly to very poorly drained soils usually result from a high water table, where water is removed so slowly that the soil is saturated or remains wet for long periods during the growing season. These soils are very deep, extending to a depth of 50" or more, and consist of fine sandy loams and mucks.

2.1.4 Hydrology

Precipitation on the Ware River watershed is fairly well distributed throughout the year. The average annual precipitation recorded since 1931 has been 43.25 inches or approximately 73 billion gallons received annually over the entire watershed. The average annual stream flow for this period recorded at Shaft #8 and the weir below has been 39.3 billion gallons, or 53% of the average annual precipitation (MDC/MWRA records).

The Ware River at the Intake Works is a 4th order stream formed by the convergence of seven major tributaries. These are the Burnshirt River (2nd order), the Canesto Brook (3rd order), Natty Pond Brook (2nd order), Longmeadow Brook (2nd order), Parkers Brook (2nd order), and the East and West Branches of the Ware River (3rd and 2nd order respectively). Most of the tributaries are warm water streams with low gradients, although there are segments of each where the gradients increase. Stream channel characteristics vary from entrenched to unconfined, but the greatest percentage is in the latter category. The channel pattern ranges from regular to tortuous meandering. In total, these tributaries travel about 77 miles to the Intake Works. The general drainage pattern is from northeast to southwest, although there are some major deviations that are the result of the last glaciation. There are sixteen large ponds scattered over the watershed, ranging in size from about 30 acres to over 100 acres. The Division controls the entire shoreline on four of these and part of the shoreline on an additional five. Two of the remaining seven ponds are maintained by the City of Fitchburg as a drinking water supply. The remaining five are privately owned and are developed to varying degrees.

Wetlands are a major part of this hydrologic system, accounting for more than 3,500 acres on Division lands on the Ware River watershed. They include coniferous and deciduous wetlands as well as those dominated by shrub and herbaceous cover. Over the past decade, a number of these have shifted from forested wetlands to shrub and open wetlands, as a direct result of an increase in beaver activity.

Wetland Expanded by Beaver

2.2 Paleoenvironments

(Note: this section is quoted from the September 1990 report on cultural resources prepared for the MDC / DWM by the Cultural Resource Group of Louis Berger & Associates, Inc. It is included here for general information on post-glacial development of the landscape, and to provide a context for prehistoric cultural resources protection)

"Prior to prehistoric man's entry into central Massachusetts, glaciers had scoured the landscape. Glacial Lake Nashua occupied the approximate position of the Wachusett Reservoir and another, Lake

Hitchcock, was located from 10 to 15 miles west of Quabbin. The lakes were apparently gone or recently drained as prehistoric Native Americans began to populate the area.

Forests of this early time are characterized as spruce parkland and spruce woodland with admixtures of some deciduous elements creating a species mosaic that has no modern analog (Curran and Dincauze 1977). Excessively drained glacial landforms would have been attractive to both man and animal during this time of cooler and wetter climate. The biological carrying capacity of area forests would have been less than that of modern habitats in the same area but greater than what can be ascribed to modern conifer-dominated forests.

Bogs, marshes, and ponds probably characterized many lowland environments as they do today. The effects of beaver populations on these lowland environments during prehistoric times cannot be accurately evaluated. Beaver are responsible for many of the modern wetland features. The types of vegetation associated with them, however, would have been substantially different. Nonetheless, we can assume that these features would have been game-attracting habitats. Extinct and more northern-adapted animal species would have existed in the area including mastodon and caribou. Now-extinct drainage patterns were probably viable low order streams. The velocity of streams in general was probably great as they handled glacial meltwater.

As regional climates began warming circa 8,000 BC, the spruce woodland was eventually replaced by a conifer-deciduous forest in which pine was heavily represented (Dincauze and Mulholland 1977). No dramatic changes in the biological carrying capacity of the project region are postulated although northern animal species were likely being supplanted by species more common to the area today. Streams were undoubtedly prolific, even in comparison with the well-watered settings of the present time.

Climates circa 6,000 BC and 1,000 BC are viewed as radically oscillating with warm temperatures and decreased rainfall being the overall trend. Windblown soils found in Central Massachusetts and the Middle Connecticut River Valley (Johnson and Stachiw 1985; Johnson and Mahlstedt 1984; Dincauze et al., 1976) may be an indirect result of this period referred to as the Thermal Maximum. Pine-oak forests give way by 4,000 BC to a temperate deciduous forest characterized by oak and hemlock. These new plant communities, together with adapted animal species, would have dramatically increased the carrying capacity of local environments and the range and density of resources that could be exploited by humans. Although many upland and low order streams may have become intermittent or extinct at this time, the quality of upland and lowland environments was dramatically increased. Seasonal changes were probably first pronounced during this period in terms of the fluctuating productivity of biological resources exploited by man. At the same time, decreasing rates of sea level rise would have helped to stabilize anadromous fish populations and regularize their appearance in local areas. Climatic shifts circa 1,000 BC and later are viewed as minor and resulted in no major alterations of regional environments. The quality of environments in Division watershed areas was essentially modern by 1,000 BC if not earlier."

2.3 Regional Land Use History

2.3.1 Prior to European Settlement

In order to understand the present forest and to predict what may occur in the future, it is essential to look at the forces that shaped the forest in the past. The primeval forest of Central Massachusetts consisted of both deciduous and coniferous species. The area lies within the Transition Zone between the Northern Hardwood Forest characterized by beech, sugar maple and birch, and the Central Hardwood Forest composed of oak, chestnut (formerly), and red maple. White pine, pitch pine and hemlock were

also present in this primeval forest. White pine made up the main component of stands on well-drained sites, while hemlock occurred in association with hardwoods on the poorly-drained soils.

Natural disturbance plays a major role in any forest development. In New England, hurricanes and fire have been the two most influential natural disturbances following the last glaciation and both have influenced forest development before and after European settlement. Human land use has been a considerable, often complex, form of disturbance. Little is known definitively about the specific impact of Native American land use on the Central Massachusetts forest, but the arrival of European settlers brought new land use practices never before seen on this landscape.

2.3.2 Colonial Settlement

In 1686, an area called "Naquag" was purchased from the Native Americans for twenty three pounds sterling by Lancaster residents Henry Willard, Joseph Foster, Benjamin Willard and Cyprian Stevens. This area consisted of 93,160 acres and contained the present towns of Rutland, Oakham, Barre, Hubbardston, and parts of Princeton and Paxton. The entire present Division holdings were originally part of this purchase. In 1713, the proprietors petitioned the General Court for confirmation of their deed. It was granted the following year with the stipulation that within seven years, sixty families be settled on the property. Lots were surveyed in Rutland, and within two years permanent homes were built. Over the next three decades, the towns of Oakham, Barre, and Hubbardston were settled. All four communities were situated on hilltops surrounding the Upper Ware River Valley. The natural meadows along Longmeadow Brook in Pine Plains and along the Ware River were held as common land for grazing, while land closer to the settlements was being cleared. The abundance of high quality timber in close proximity to streams with the capacity to generate power attracted the settlers into the forest. According to historic records, the Pine Plains area contained vast quantities of high quality white pine and pitch pine favored in building. Sawmills and gristmills were built along several streams, and primitive roads were constructed to move materials to and from the Valley. Only the largest and best quality trees were removed. These products were for local use and served only the few settlements that rimmed the valley.

In the late 18th century, settlement of the valley began in earnest. The forest was cleared on the bottom lands. The completion of the Massachusetts highway connecting Northampton and Worcester simplified the transport of goods. The agricultural operations grew in number and size, and the forest area was reduced.

During the first half of the 19th century, an estimated seventy percent of Central Massachusetts land was in agricultural use. The remaining forests were used for lumber and for fuelwood. The best quality trees were removed for building and the small trees for fuelwood. During this period, practically all the land was altered in some way by human land use.

In 1815 and 1821, minor hurricanes swept through the area, leveling portions of the remaining forested lands. Hemlock was a major component of these mixed stands because the pine and hardwood had been removed. Following the disturbance events, hemlock seedlings and hardwood sprouts were released and perpetuated the existing type.

2.3.3 Land Abandonment

A decline in agriculture started about 1840 and continued until the turn of the century. The completion of the Erie Canal and the expansion of the railroads into the rich farmlands of the Midwest, as

well as the growth of industry and the discovery of gold in California, drew farmers from rocky New England soil.

The Upper Ware River Valley was no exception. Many farms were abandoned, while other farming operations ceased when the owners found work in the industrial communities growing in the valley. The availability of water power made the valley attractive to industry. The completion of the Central Massachusetts Railroad and Ware River Branch of the Penn Central Railroad in the 1870s facilitated the procurement of raw materials and the distribution of products over a large area. In 1872, William Stearns purchased a mill in West Rutland to manufacture bed comforters and cotton batting. By 1900, the company employed one hundred people. New Boston in North Rutland was the site of the Moulton Brothers shoddy mill (shoddy was a lower-quality material woven from reclaimed wool). A gristmill and sawmill were situated in Coldbrook, on the western side of the watershed. All these industrial communities were still in operation in the late 1920s when the Commonwealth purchased the area for drinking water supply protection.

The forest moved quickly to reclaim abandoned farm lands. The sod and grasslands of open fields furnished an ideal seed bed for white pine which rapidly established itself. Some scattered hardwoods were intermingled, such as oak, chestnut, red maple, and gray birch, but few were able to compete in the thick stands of white pine. As these stands matured and the canopies rose, increased understory light favored the seedling establishment of shade tolerant hardwoods, such as oak and chestnut. By the turn of the century, the commercial value of the second-growth, old-field pine stands became evident to many, even though the quality of these stands was vastly inferior to the old growth pine. Industries based on the use of the inferior quality pine grew up all over Worcester County. Box shops, pail, match, heel and woodenware factories utilized millions of board feet.

Many old-field stands within the Ware River watershed were removed during this period. Their density made clear-cutting the most practical means of harvesting. All trees of sufficient size with some value as lumber were removed. These operations released the understory hardwoods. Some of the light seeded hardwoods were also present, such as gray birch and poplar, but as the stands matured these "pioneer" species succumbed to competition. On the moist poorly drained sites, American chestnut and red and scarlet oak predominated. These species grew well and formed high quality stands. On dry sites black oak, white oak, and some red oak formed the major component of slow-growing, low-quality stands. As a result of the heavy slash left from logging, fire destroyed many young hardwood stands. Where the fires were not particularly hot, the hardwoods resprouted and continued to develop. Where the organic matter was severely burned, however, stand composition changed. White pine and mixtures of low quality hardwoods became reestablished. Such stands have developed slowly, and only the pine component has economic value. The Cunningham property in North Hubbardston is an example of this condition.

In 1903, another disturbance event occurred, which changed the species composition of many of the hardwood stands. The chestnut blight was introduced into this country, and within two decades had eliminated the chestnut as an important element of the New England forest. This was a severe blow to the economy. Chestnut is extremely durable and easy to work and was favored as both lumber and fuelwood. On most sites it outgrew oak. With the loss of chestnut, oaks became the dominant species in hardwood stands.

2.4 Present Status of Ware River Forests

The Ware River watershed is part of the Worcester hills ecoregion, an area with a wide range of glacial influences. There is an abundance of outwash soils, tills in drumlins, washed tills, and tills of varying degrees of drainage, all are of varying depth. The glacial outwash clogged many drainages creating abundant wetlands. This region once supported a forest dominated by the long-lived oak, chestnut, pine, and hemlock. The moist tills also supported pockets of northern hardwoods. Most of the original forest was cleared for agricultural purposes, such as pasture or crop land. As mentioned previously, most of this agricultural land had been abandoned by the turn of the century, resulting in a steady conversion from open agricultural habitat to forest cover. In the past 20-30 years this region has experienced significant population growth and consequently continues to be subdivided and developed for residential and commercial use. As a result, average private ownership parcel size has shrunk. Presently, approximately 70% of this region is covered by forest. There has been a gradual shift in forest composition as well; the amount of oak and pine has decreased and the amount of red maple, hemlock and black birch has increased. Red maple has become the most common tree in Massachusetts, taking over from white pine, according to statewide surveys. Black birch and hemlock have made the greatest gains in abundance due to private land cutting practices that have consistently harvested the more valuable pines and oaks.

The forest that presently covers most of the Division holdings at the Ware River resulted from: 1) natural succession following agricultural abandonment, 2) heavy cutting (mostly white pine) 60-100 years ago and 3) Division forest management activities over the past 30 years. It is the product of the interplay of environmental and social factors over time. The Industrial Revolution, agricultural abandonment, railroad construction and land takings for metropolitan Boston's water supply are some of the social factors that have influenced forest composition, against a backdrop of environmental factors that have included the hurricane of 1938, the chestnut blight, and Dutch elm disease. This legacy of both social and environmental factors is apparent in the forest as it exists today.

2.5 Ware River Flora

As part of an ongoing effort to address the biological diversity within its watersheds, the Division continues to gather records of present species. During 1995 and 1996, MDC contracted with the University of Massachusetts Herbarium to inventory proposed timber harvesting areas on the Quabbin and Ware River watersheds in search of rare plant species. The herbarium staff also compiled a flora, a list of all plant species encountered. This Ware River flora is included in Table 1.

Epigaea repens, *Trailing arbutus. MA state flower*.

TABLE 1: PLANT SPECIES OCCURRING ON THE WARE RIVER WATERSHED

Field List – Flora
1996 Survey of Proposed Harvesting Lots
Karen Searcy - U Mass Herbarium
rare species underlined and bold;
*invasive species

Dicots

Acer pensylvanicum	Striped maple
Acer rubrum	Red maple
Acer saccharum	Sugar maple
Achillea millefolium	Common yarrow
Actaea pachypoda	Doll's eyes
Actaea rubra	Red baneberry
Actaea sp.	Baneberry
Amelanchier sp.	Shadbush
Amelanchier (canadensis?)	Swamp shadbush
Amelanchier bartramiana	Bartram's shadbush
Amphicarpaea bracteata	Hog peanut
Anemone quinquefolia	Wood anemone
Apocynum androsaemifolium	Spreading dogbane
Apocynum sp.	Dogbane
Aquilegia Canadensis	Wild columbine
Aralia nudicaulis	Wild sarsaparilla
Aronia arbutifolia	Cherry
Aronia melanocarpa	Choke cherry
Asclepius sp.	Milkweed
Asclepius syriaca	Common milkweed
Aster acuminatus	Whorled aster
Aster divaricatus	White wood aster
Baptisia tinctorea	False indigo
**Berberis thunbergii*	Japanese barberry
**Berberis vulgaris*	Common barberry
Betula alleghaniensis	Yellow birch
Betula lenta	Black birch
Betula papyrifera	White birch
Betula populifolia	Gray birch
Carpinus caroliniana	Iron wood
Carya sp.	Hickory
Castanea dentata	Chestnut
Chamaedaphne calyculata	Leather-leaf
Chimaphila maculata	Spotted wintergreen
Chimaphila umbellata	Pipsissewa
Chrysosplenium americanum	Golden saxifrage
Circaea alpine	Enchanters nightshade
Circaea lutetiana var. canadensis	Canadian nightshade
Clematis virginiana	Virgin's bower
Comandra umbellata	Umbellate toadflax
Comptonia peregrine	Sweet fern
Convolvulus sp.	Bindweed
Coptis trifolia	Goldthread
Cornus alternifolia	Alternate-leaf dogwood
Cornus amomum	Silky dogwood
Cornus canadensis	Bunch berry
Cornus racemosa	Red panicle dogwood
Cornus sp.	Dogwood
Corydalis sempervirens	Pale corydalis
Corylus americana	American hazelnut
Corylus cornuta	Beaked hazelnut
Crataegus sp.	Hawthorn
Dalibarda repens	Robin-run-away
Diervilla lonicera	Bush honeysuckle
Drossera rotundifolia	Round-leafed sundew
Epigaea repens	Trailing arbutus
Euonymus alatus	Winged spindle-tree
Fagus grandifolia	Beech
Fragaria sp	Strawberry
Fragaria virginiana.	Common strawberry
Fraxinus americana	White ash
Fraxinus pennsylvanica	Green ash
Fraxinus sp.	Ash
Galium sp.	Bedstraw
Galium trifidum	Three-cleft bedstraw
Gaultheria procumbens	Wintergreen
Gaylussacia baccata	Black huckleberry
Gaylussacia sp.	Huckleberry
Geranium maculatum	Wild geranium
Glechoma hederacea	Ground ivy
Hamamelis virginiana	Witch hazel
Hemerocallis sp.	Day-lily
Hepatica sp.	Liverleaf
Hedyotis caerula	Bluets
Hydrocotyle americana	Water-pennywort
Hypericum sp.	St. John's wort
Ilex verticillata	Winterberry
Impatiens capensis	Jewelweed
Kalmia angustifolia	Sheep laurel
Kalmia latifolia	Mountain laurel
Leonurus cardiaca	Common motherwort
Lespedeza sp.	Bush-clover
Lindera benzoin	Spicebush

**Lonicera sp.*	Honeysuckle
**Lonicera tatarica*	Tartarian honeysuckle
Lycopus uniflorus	Northern bugleweed
Lyonia ligustrina	Maleberry
Lysimachia ciliata	Hairy loosestrife
Lysimachia quadrifolia	Whorled loosestrife
Melampyrum lineare	Cow wheat
Mimulus ringens	Gaping monkey flower
Mitchella repens	Partridge berry
Moneses uniflora	One-flowered pyrola
Monotropa hypopithys	Pine-sap
Monotropa uniflora	Indian-pipe
Myosotis scorpioides	True forget-me-not
Myrica gale	Sweet gale, meadow-fern
Nemopanthus mucronatus	Mountain holly
Nyssa sylvatica	Black gum
Orobanche uniflora	One-flowered cancer-root
Ostrya virginiana	American hop-hornbeam
Oxalis sp.	Wood sorrel
Parthenocissus quinquefolia	Virginia creeper
Parthenocissus sp.	Virginia creeper
Polygala paucifolia	Fringed polygala
Polygonum sagittatum	Tearthumb
Populus grandidentata	Large-toothed aspen
Populus tremuloides	Quaking aspen
Potentilla canadensis	Canadian cinquefoil
Potentilla simplex	Old-field cinquefoil
Potentilla sp.	Cinquefoil
Prenanthes sp.	Rattlesnake root
Prenanthes trifoliolata	Gall-of-the-earth
Prunus pennsylvanica	Fire cherry
Prunus serotina	Black cherry
Prunus virginiana	Choke cherry
Prunus sp.	Cherry
Pyrola elliptica	Shinleaf
Pyrola rotundifolia	Round-leafed pyrola
Pyrola sp.	Pyrola
Pyrus malus	Apple
Quercus alba	White oak
Quercus ilicifolia	Scrub oak
Quercus rubra	Red oak
Quercus sp.	Oak
Quercus velutina	Black oak
Ranunculus recurvatus	Buttercup
Ranunculus sp.	Buttercup
Rhamnus frangula	Alder-buckthorn
**Rhamnus sp*	Buckthorn
Rhododendron canadense.	Rhodora
Rhododendron sp.	Rhododendron
Rhododendron viscosum	Swamp azalea
Rhus copallina	Winged sumac
Rhus glabra	Smooth sumac
Rhus sp.	Sumac
Ribes glandulosum	Skunk currant
Ribes hirtellum	Bristly currant
Ribes sp.	Currant
Rosa multiflora	Multiflora rose
Rubus allegheniensis	Black raspberry
Rubus flagellaris	Dewberry
Rubus hispidus	Swamp dewberry
Rubus idaeus	Raspberry
Rubus sp.	Blackberry
Rumex acetocella	Sorrel
Sambucus canadensis	Common elder
Sambucus pubens	Stinking elder
Sassafras albidum	Sassafras
Sedum purpureum	Garden orpine
Senecio aureus	Squaw weed
Solanum dulcamara	Nightshade
Solidago sp.	Goldenrod
Sorbus aucuparia	Mountain ash
Spiraea alba var. latifolia	Meadowsweet
Spiraea tomentosa	Steeple bush
Symphoricarpos albus	Snowberry
Syringa vulgaris	Common lilac
Taraxacum officinale	Common dandelion
Thalictrum polygamum	Tall meadow rue
Thalictrum sp.	Meadow rue
Tiarella cordifolia	Foam flower
Tilia Americana	Basswood
Triadenum sp.	St. John's wort
Trientalis borealis	Starflower
Ulmus americana	American elm
Ulmus rubra	Slippery elm
Ulmus sp.	Elm
Vaccinium angustifolium	Low-bush blueberry
Vaccinium corymbosum	High-bush blueberry
Vaccinium macrocarpon	American cranberry
Vaccinium sp.	Blueberry
Vaccinium pallens	Early sweet blueberry
Veronica officinalis	Common speedwell
Viburnum acerifolium	Maple-leafed viburnum
Viburnum alnifolium	Hobblebush
Viburnum cassinoides	Witherod

Viburnum dentatum var. lucidum	Southern arrow wood
Viburnum lentago	Nannyberry
Viburnum sp.	Viburnum
Viola blanda	Mild violet
Viola conspersa	Dog violet
Viola cucullata	Marsh violet
Viola macloskii ?	
Viola sororia	
Viola sp.	Violet

Monocots

Andropogon scoparius	Bluestem
Anthoxanthum odoratum	Sweet vernal grass
Arisaema sp.	Jack-in-the-pulpit
Arisaema triphyllum	Small jack-in-the-pulpit
Brachyelytrum erectum	
Carex argyrantha	Silvery-flowered sedge
Carex (bracteosae group)	
Carex canescens	Silvery bog sedge
Carex communis	Colonial sedge
Carex crinita	Long-haired sedge
Carex debilis	Weak sedge
Carex folliculata	Follicle-bearing sedge
Carex gracillima	Slender sedge
Carex intumescens	Swelled-up sedge
Carex laxiflora	Loosely-flowered sedge
Carex (laxiflora group)	
Carex leptalea	Delicate sedge
Carex normalis	Right-angled sedge
Carex novae-angliae	New England sedge
Carex (ovales group)	
Carex pensylvanica	Penn. sedge
Carex platyphylla?	Broad-leaved sedge
Carex rosea	Rose-like sedge
Carex sp.	Sedge
Carex (stellulatae group)	
Carex stricta	Erect sedge
Carex stipata	Crowded sedge
Carex swanii	Swan sedge
Carex sylvatica	Sedge-of-the-woods
Carex trisperma?	Three-seeded sedge
Carex vestita	Clothed sedge
Carex vulpinoidea	Foxtail-flowered sedge
Clintonia borealis	Yellow clintonia
Convallaria majalis	Lily of the valley
Cypripedium acaule	Pink lady's slipper
Danthonia spicata	Junegrass
Eleocharis sp.	Spike-rush
Epipactis helleborine	Helleborine
Festuca ovina	Sheep festcue
Glyceria striata	Fowl-meadow grass
Goodyera pubescens	Rattlesnake plantain
Goodyera tesselata	Checkered rattlesnake plantain
[Grass species]	
Habenaria bracteata	
Habenaria sp.	Orchis
Iris versicolor	Blue flag
Juncus effusus	Soft rush
Lilium philadelphicum	Wood lily
Lilium sp.	Lily
Luzula sp.	Woodrush
Maianthemum canadense	Canada mayflower
Medeola virginiana	Indian cucumber root
Orchid sp.	Orchid
Oryzopsis sp.	Rice grass
Panicum latifolium	Panic grass
Polygonatum pubescens	Hairy Solomon's seal
Polygonatum sp.	Solomon's seal
Sisyrinchium sp.	Blue-eyed grass
Smilacina racemosa	False solomon's seal
Smilax herbacea	Jacob's ladder
Smilax sp.	Greenbrier
Streptopus sp.	Twisted-stalk
Symplocarpus foetidus	Skunk cabbage
Trillium cernuum	Nodding trillium
Trillium sp.	Trillium
Trillium undulatum	Painted trillium
Uvularia perfoliata	Bellwort
Uvularia sessilifolia	Wild oats
Veratrum viride	False hellebore

Fern Allies

Equisetum arvense	Common horsetail
Equisetum sylvaticum	Horsetail
Diphasiastrum digitatum	Trailing evergreen
Diphasiastrum tristachyum	Ground pine
Huperzia lucidula	Shiny clubmoss

Lycopodium annotinum	Bristly clubmoss
Lycopodium clavatum	Common clubmoss
Lycopodium dendroideum	Northern ground pine
Lycopodium hickeyi	Hickey's clubmoss
Lycopodium obscurum	Tree clubmoss
Lycopodium sp.	Clubmoss

Ferns

Athyrium filix-femina	Lady fern
Athyrium thelypteroides	Silvery spleen
Botrychium virginianum	Rattlesnake fern
Cystopteris fragilis	Fragile fern
Dennstaedtia punctilobula	Hay-scented fern
Dryopteris cristata	Crested wood fern
Dryopteris filix-mas	Male fern
Dryopteris intermedia	Spinulose wood fern
Dryopteris marginalis	Marginal shield fern
Dryopteris spinulosa	Spinulose wood fern
Gymnocarpium dryopteris	Oak fern
Onoclea sensibilis	Sensitive fern
Osmunda cinnamomea	Cinnamon fern
Osmunda claytoniana	Interrupted fern
Osmunda regalis	Royal fern
Polypodium virginianum	Rock polypody
Polystichum acrostichoides	Christmas fern
Pteridium aquilinium	Bracken fern
Thelypteris noveboracensis	New York fern
Thelypteris palustris	Marsh fern
Thelypteris phagopteris	Beech fern

Gymnosperms

Juniperus communis	Common juniper
Juniperis virginiana	Red cedar
Larix deciduas	Deciduous larch
Picea rubens	Red spruce
Picea sp.	Spruce
Pinus resinosa	Red pine
Pinus rigida	Pitch pine
Pinus strobes	White pine
Taxus canadensis	American yew
Tsuga canadensis	Hemlock

In 2001, Professor Robert Bertin (College of the Holy Cross, Worcester) identified a vigorous population of 100-200 plants of *Polygala verticillata* (whorled milkwort) along the Prison Camp Road. This species is a Watch List species in Massachusetts, which means that it remains on the Natural Heritage and Endangered Species Program list of species that are suspected to be rare or declining, but for which information is currently lacking.

The above serves as a starting point for assessing the diversity of plant species present on the Ware River watershed. Based upon historic records from the Herbarium and other sources, there is some likelihood that a comprehensive search would find additional, uncommon plant species on the Ware River watershed. A list of these species is found in Appendix II, along with a general list of habitats in which rare plant species are likely to be present.

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